SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F-21-R-42

Name: Diamond Lake **County**: Minnehaha
Legal Description: T104N-R52W-Sec. 5
Location from nearest town: 13 miles north and 2 miles west of Humboldt, SD

Dates of present survey: July 7-9, 2009
Date last surveyed: July 24-26, 2007

Primary Game and Forage Species	Secondary and Other Species
Walleye	Black Bullhead
Yellow Perch	Northern Pike
	White Sucker
	Common Carp
	Green Sunfish
	Orange-spotted Sunfish
	Channel Catfish
	Black Crappie
	Bluegill

PHYSICAL DATA

Surface Area: 256 acres **Watershed area**: No data available
Maximum depth: 12 feet **Mean depth**: 6 feet
Volume: No data available **Shoreline length**: No data
Contour map available: No **Date mapped**: 2002 (shoreline)
Lake elevation observed during the survey: Full
Beneficial use classifications: (5) warmwater semi-permanent fish propagation, (7) immersion recreation, (8) limited-contact recreation and (9) fish and wildlife propagation and stock watering.

Ownership of Lake and Adjacent Lakeshore Properties

Diamond Lake is listed as meandered public water in the State of South Dakota Listing of Meandered Lakes. Game, Fish, and Parks (GFP) owns the majority of the lake basin as a Game Production Area and manages the fishery. The remainder of the shoreline is privately owned.

Fishing Access

The Diamond Lake Access Area was upgraded in 2005. It consists of a new concrete plank boat ramp, small gravel parking area, a new boat dock and a toilet. Shore fishing access is available in the access area and along the county road grade on the south end of the lake.

Field Observations of Water Quality and Aquatic Vegetation

The water was fairly turbid during the survey with a Secchi depth measurement of 36 cm (14.0 in). Some common cattail (*Typha spp.*) and bulrush (*Scirpus spp.*) exist in shallow bays.

BIOLOGICAL DATA

Methods:

Diamond Lake was sampled on July 7-9, 2009 with three overnight gill net sets and ten overnight trap net sets. The trap nets are constructed with 19-mm-bar-mesh (¾ in) netting, 0.9 m high x 1.5 m wide (3 ft high x 5 ft wide) frames and 18.3 m (60 ft) long leads. The gill nets are 45.7 m long x 1.8 m deep (150 ft long x 6 ft deep) with one 7.6 m (25 ft) panel each of 13, 19, 25, 32, 38 and 51-mm-bar-mesh (½, ¾, 1, 1¼, 1½, and 2 in) monofilament netting. Sampling locations are displayed in Figure 4.

Results and Discussion:

Gill Net Catch

Yellow perch (34.4%) were the most abundant species in the gill net catch (Table 1). Common carp, walleye, black bullhead and black crappie were also sampled.

Table 1. Total catch from three overnight gill net sets at Diamond Lake, Minnehaha County, July 7-9, 2009.

Species	Number	Percent	CPUE[1]	80% C.I.	Mean CPUE*	PSD	RSD-P	Mean Wr
Yellow Perch	33	34.4	11.0	±4.5	32.8	85	12	101
Common Carp	24	25.0	8.0	±1.3	16.1	92	0	90
Walleye	20	20.8	6.7	±2.8	7.2	6	6	81
Black Bullhead	18	18.8	6.0	±0.7	93.3	72	0	90
Black Crappie	1	1.0	0.3	±0.4	0.0	--	--	--

*5 years (2000, 2002, 2004, 2006, 2007)

Table 2. Catch per unit effort by length category for various fish species captured with gill nets in Diamond Lake, July 7-9, 2009.

Species	Substock	Stock	S-Q	Q-P	P+	All sizes	80% C.I.
Yellow Perch	--	11.0	1.7	8.0	1.3	11.0	±4.5
Common Carp	--	8.0	0.7	7.3	--	8.0	±1.3
Walleye	1.0	5.7	5.3	--	0.4	6.7	±2.8
Black Bullhead	--	6.0	1.7	4.3	--	6.0	±0.7
Black Crappie	0.3	--	--	--	--	0.3	±0.4

Length categories can be found in Appendix A.

[1] See Appendix A for definitions of CPUE, PSD, and mean Wr.

Trap Net Catch

Black bullheads (51.2%) and walleye (19.5%) were the most abundant species in the trap net catch (Table 3). Other species caught included common carp, black crappie, yellow perch, hybrid sunfish, green sunfish, and white sucker.

Table 3. Total catch from ten overnight trap net sets at Diamond Lake, Minnehaha County, July 8-9, 2009.

Species	Number	Percent	CPUE	80% C.I.	Mean CPUE*	PSD	RSD-P	Mean Wr
Black Bullhead	171	51.2	17.1	±2.3	776.0	100	0	86
Walleye	65	19.5	6.5	±1.7	2.0	9	9	78
Common Carp	33	9.9	3.3	±0.8	10.0	97	30	83
Black Crappie	27	8.1	2.7	±1.5	0.1	36	9	104
Yellow Perch	26	7.8	2.6	±1.5	4.1	42	0	103
Hybrid Sunfish	5	1.5	0.5	±0.6	0.0	--	--	--
Green Sunfish	4	1.2	0.4	±0.4	0.3	--	--	--
White Sucker	3	0.9	0.3	±0.3	0.3	--	--	--

*5 years (2000, 2002, 2004, 2006, 2007)

Table 4. Catch per unit effort by length category for various fish species captured with trap nets in Diamond Lake, July 8-9, 2009.

Species	Substock	Stock	S-Q	Q-P	P+	All sizes	80% C.I.
Black Bullhead	--	17.1	17.1	--	--	17.1	±2.3
Walleye	3.1	3.4	3.1	--	0.3	6.5	±1.7
Common Carp	--	3.3	0.1	2.2	1.0	3.3	±0.8
Black Crappie	1.6	1.1	0.7	0.3	0.1	2.7	±1.5
Yellow Perch	--	2.6	1.5	1.1	--	2.6	±1.5
Hybrid Sunfish*	--	--	--	--	--	0.5	±0.6
Green Sunfish	--	0.4	--	0.4	--	0.4	±0.4
White Sucker	--	0.3	--	--	0.3	0.3	±0.3

*No length categories established.
Length categories can be found in Appendix A.

Walleye

Management objective: Maintain a walleye fishery with a gill-net CPUE of at least 15 and PSD range of 30-60.

On January 1, 2009, Diamond Lake returned to standard, statewide walleye regulations after five years of evaluating a one fish over 24" special regulation. Despite considerable stocking effort and the protective harvest regulation, walleye abundance failed to achieve our expectations (Table 5). Diamond Lake will still be managed for walleyes by stocking as needed to maintain the fishery.

Growth of 1-3 year old walleyes in 2009 was relatively slow (Table 6) and condition overall has declined since 2002 (Table 5). This was another factor in the decision to remove the special regulation.

Table 5. Walleye gill-net CPUE, PSD, RSD-P, and mean Wr for Diamond Lake, Minnehaha County, 2000-2009.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Mean*
CPUE	11.5		5.7		2.3		10.0	6.7		6.7	7.2
PSD	88		93		100		49	--		6	83
RSD-P	0		21		17		11	--		6	12
Mean Wr	97		102		92		85	82		81	92

*5 years (2000, 2002, 2004, 2006, 2007)

Table 6. Weighted mean length at capture (mm) for walleye captured in gill nets in Diamond Lake, Minnehaha County, 2004-2009. Note: sampling was conducted at approximately the same time during each year allowing comparisons among years to monitor growth trends. Sample size in parentheses.

Year	1	2	3	4	5	6	7	8	9	10	11	12
2009 (20)	216 (3)	280 (8)	303 (8)	--	--	525 (1)	--	--	--	--	--	--
2007 (20)	208 (15)	254 (3)	--	--	454 (1)	483 (1)	--	--	--	--	--	--
2006 (26)	236 (9)	377 (7)	378 (7)	--	--	516 (2)	498 (1)	--	--	--	--	--
2004 (8)	--	--	403 (2)	424 (3)	494 (2)	560 (1)	--	--	--	--	--	--

Yellow Perch

Management objective: Maintain a yellow perch population with a gill-net CPUE of at least 50 and a PSD range of 30-60.

Yellow perch gill net CPUE has been very low since 2002 (Table 7). The mean length of the yellow perch sampled this year was 215 mm (8.5 in) (Figure 2). The decline of the perch population is likely related to the same conditions responsible for a general, region-wide lack of perch reproduction since 2002.

Yellow perch fingerlings marked with oxytetracycline (OTC) (100,700) from Blue Dog State Fish Hatchery were stocked in 2009. In a sample of 58 age-0 perch collected in fall 2009, 48% were marked. Hopefully these hatchery-stocking fingerlings helped create a strong year class in 2009.

Table 7. Yellow perch gill-net CPUE, PSD, RSD-P, and mean Wr for Diamond Lake, Minnehaha County, 2000-2009.

	2000	2002	2003	2004	2005	2006	2007	2009	Mean*
CPUE	65.0	73.3		9.3		15.0	1.7	11.0	32.9
PSD	2	8		93		87	--	85	48
RSD-P	0	0		0		16	--	12	4
Mean Wr	87	107		97		81	--	101	93

*5 years (2000, 2002, 2004, 2006, 2007)

Black Bullhead

Management objective: Maintain a black bullhead population with a trap-net net CPUE of less than 100.

The black bullhead trap net CPUE was 17.1, the lowest ever recorded (Table 8). A PSD of 100 with a mean length of 266 mm (10.5 in) indicate an improving size structure (Figure 3). The reduction in bullhead numbers and improved size is likely related to the introduction and maintenance of walleyes as a primary predator in the lake coupled with several years of poor natural recruitment (Figure 3).

Table 8. Black bullhead trap-net CPUE, PSD, RSD-P, and mean Wr for Diamond Lake, Minnehaha County, 2000-2009.

	2000	2002	2004	2006	2007	2009	Mean*
CPUE	2000.0	1,229.4	104.7	289.4	256.6	17.1	776.0
PSD	0	63	69	9	28	100	34
RSD-P	0	0	7	0	1	0	2
Mean Wr	--	105	86	85	85	86	90

*5 years (2000, 2002, 2004, 2006, 2007)

All Species

Black crappie CPUE was the highest ever recorded, while the abundance of other species remains within previously observed ranges (Table 9).

Table 9. Gill-net (GN) and trap-net (TN) CPUE for all fish species sampled in Diamond Lake, Minnehaha County, 2000-2009.

Species	2000	2002	2003	2004	2005	2006	2007	2009
COC (GN)	0.5	21.7		4.3		50.0	4.0	8.0
COC (TN)	1.0	8.0		9.5		19.8	11.7	3.3
WHS (GN)	0.5	--		--		--	--	--
WHS (TN)	0.2	0.3		0.3		0.5	0.1	0.3
BLB (GN)	206.5	106.7		108.0		33.3	12.0	6.0
BLB (TN)	2000.0	1,229.4		104.7		289.4	256.6	17.1
CCF (GN)	--	--		--		--	--	--
CCF (TN)	--	--		0.1		--	--	--
NOP (GN)	4.0	1.3		0.3		--	--	--
NOP (TN)	0.4	--		0.5		0.3	0.2	--
GSF (GN)	--	--		--		--	--	--
GSF (TN)	--	--		0.7		0.7	--	0.4
OSF (GN)	--	--		--		--	--	--
OSF (TN)	--	--		0.2		--	--	--
HYB (GN)	--	--		--		--	--	--
HYB (TN)	--	--		0.1		--	--	0.5
BLG (GN)	--	--		--		--	--	--
BLG (TN)	--	--		0.1		0.1	--	--
BLC (GN)	--	--		--		--	--	0.3
BLC (TN)	--	--		0.1		0.1	0.1	2.7
YEP (GN)	65.0	73.3		9.3		14.7	1.7	11.0
YEP (TN)	1.4	16.0		0.7		1.9	0.6	2.6
WAE (GN)	11.5	5.7		2.3		10.0	6.7	6.7
WAE (TN)	--	--		0.8		5.3	4.0	6.5

COC (Common Carp), WHS (White Sucker), BLB (Black Bullhead), CCF (Channel Catfish), NOP (Northern Pike), GSF (Green Sunfish), OSF (Orangespotted Sunfish), HYB (Hybrid Sunfish), BLG (Bluegill), BLC (Black Crappie), YEP (Yellow Perch), WAE (Walleye),

MANAGEMENT RECOMMENDATIONS

1. Maintain the walleye population by stocking as needed.

2. Aggressively stock yellow perch to reach management objectives and to provide a consistent forage base for the walleye population.

Table 10. Stocking record for Diamond Lake, Minnehaha County, 1990-2009.

Year	Number	Species	Size
1990	110	Northern Pike	Adult
1992	12,690	Northern Pike	Fingerling
	25,250	Yellow Perch	Fingerling
1993	37,000	Yellow Perch	Fingerling
1995	3,050	Yellow Perch	Adult
1997	2,640	Yellow Perch	Adult
	19,485	Yellow Perch	Fingerling
1998	27,700	Walleye	Fingerling
1999	25,600	Walleye	Fingerling
2000	27,000	Walleye	Fingerling
2001	25,600	Walleye	Fingerling
2002	263	Walleye	Adult
2003	149	Walleye	Adult
	51,200	Walleye	Fingerling
2005	24	Walleye	Adult
	8,320	Walleye	Fingerling
2006	25,680	Walleye	Fingerling
	1,771	Yellow Perch	Adult
	1,107	Yellow Perch	Juvenile
	6,645	Walleye	Large Fingerling
2007	2,232	Walleye	Large Fingerling
	476	Yellow Perch	Adult
2008	4,325	Walleye	Large Fingerling
2009	100,700	Yellow Perch	Fingerling

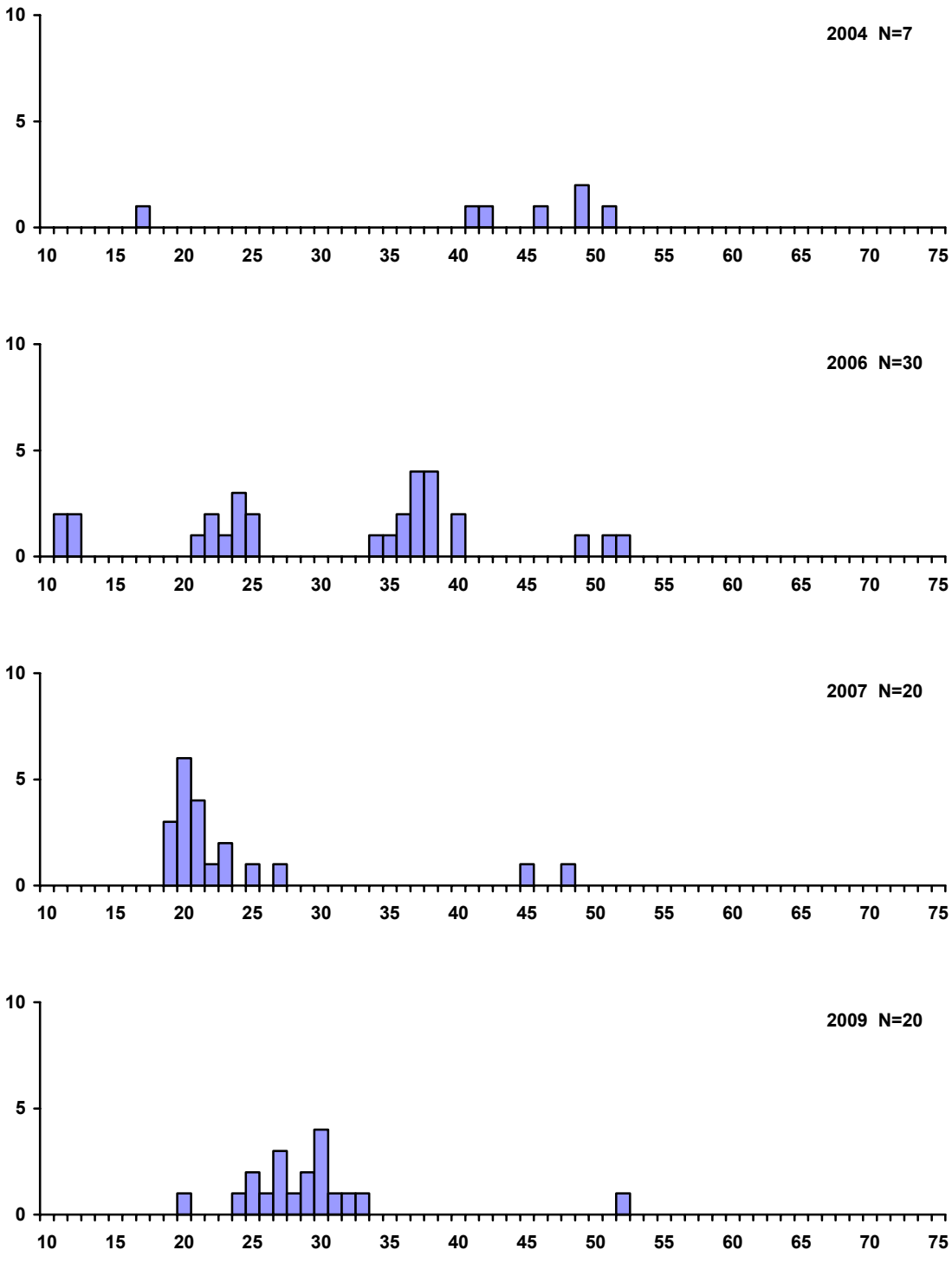

Figure 1. Length frequency histogram for walleye sampled with gill nets in Diamond Lake, Minnehaha County, 2004, 2006, 2007, and 2009.

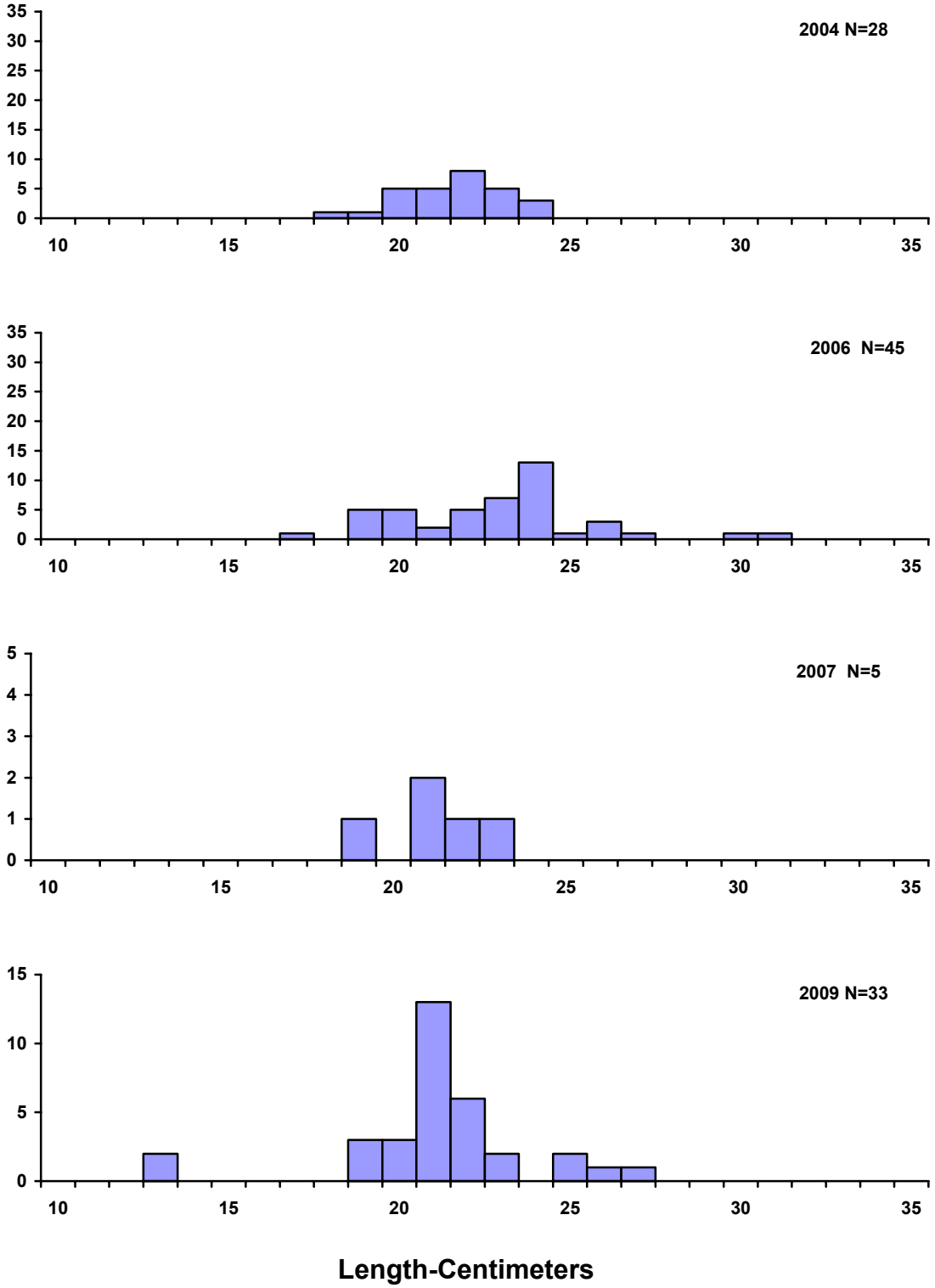

Figure 2. Length frequency histograms for yellow perch sampled with gill nets in Diamond Lake, Minnehaha County, 2004, 2006, 2007, and 2009.

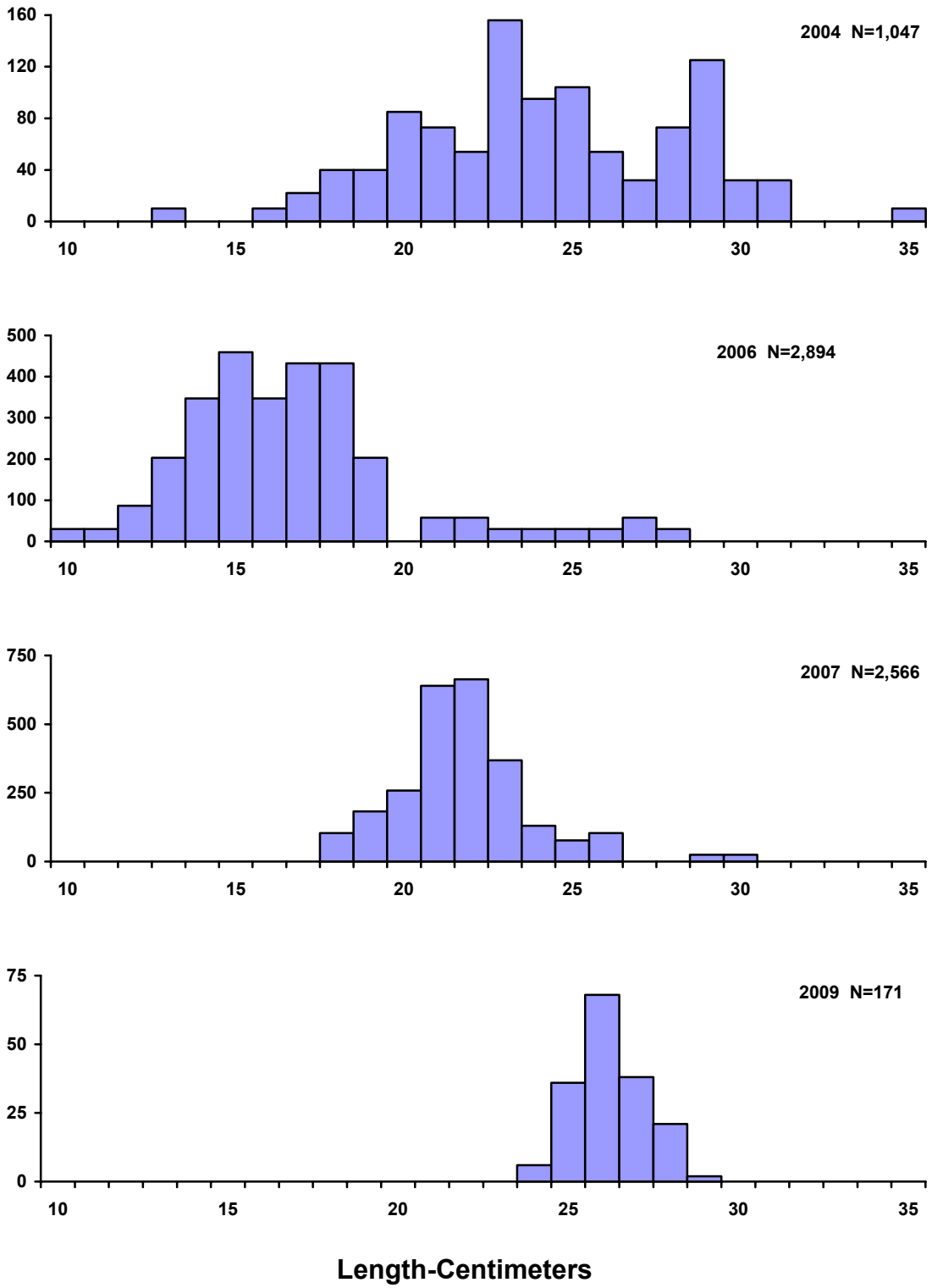

Figure 3. Length frequency histograms for black bullheads sampled with trap nets in Diamond Lake, Minnehaha County, 2004, 2006, 2007, and 2009.

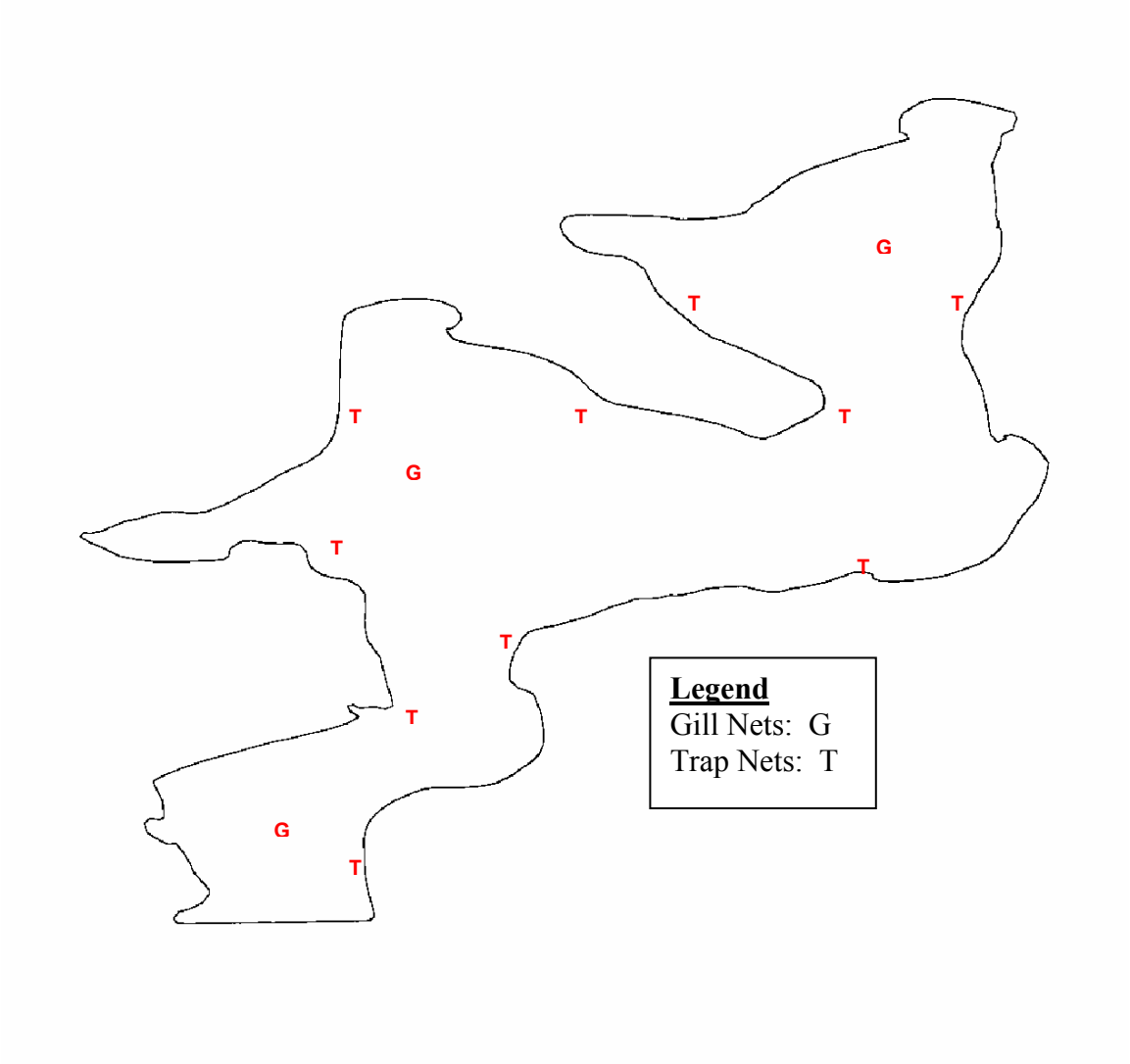

Figure 4. Sampling locations on Diamond Lake, Minnehaha County, 2009.

Appendix A. A brief explanation of catch per unit effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr).

Catch Per Unit Effort (CPUE) is the catch of animals in numbers or in weight taken by a defined period of effort. Can refer to trap-net nights of effort, gill-net nights of effort, catch per hour of electrofishing, etc.

Proportional Stock Density (PSD) is calculated by the following formula:

$$PSD = \frac{\text{Number of fish} > \text{quality length}}{\text{Number of fish} \geq \text{stock length}} \times 100$$

Relative Stock Density (RSD-P) is calculated by the following formula:

$$RSD\text{-}P = \frac{\text{Number of fish} > \text{preferred length}}{\text{Number of fish} \geq \text{stock length}} \times 100$$

PSD and RSD-P are unitless and usually calculated to the nearest whole digit.

Size categories for selected species found in Region 3 lake surveys, in centimeters.

Species	Stock	Quality	Preferred	Memorable	Trophy
Walleye	25	38	51	63	76
Sauger	20	30	38	51	63
Yellow perch	13	20	25	30	38
Black crappie	13	20	25	30	38
White crappie	13	20	25	30	38
Bluegill	8	15	20	25	30
Largemouth bass	20	30	38	51	63
Smallmouth bass	18	28	35	43	51
Northern pike	35	53	71	86	112
Channel catfish	28	41	61	71	91
Black bullhead	15	23	30	38	46
Common carp	28	41	53	66	84
Bigmouth buffalo	28	41	53	66	84
Smallmouth buffalo	28	41	53	66	84

For most fish, 30-60 or 40-70 are typical objective ranges for “balanced” populations. Values less than the objective range indicate a population dominated by small fish while values greater than the objective range indicate a population comprised mainly of large fish.

Relative weight (Wr) is a condition index that quantifies fish condition (i.e., how much does a fish weigh for its length). A Wr range of 90-100 is a typical objective for most fish species. When mean Wr values are well below 100 for a size group, problems may exist in food and feeding relationships. When mean Wr values are well above 100 for a size group, fish may not be making the best use of available prey.